THE NASA MICRO PULSE LIDAR NETWORK (MPLNET): EARLY RESULTS FROM DEVELOPMENT OF DIURNAL CLIMATOLOGIES

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ABSTRACT

The NASA Micro Pulse Lidar Network (MPLNET) is a federated network of micro pulse lidar sites, mostly co-located with the NASA Aerosol Robotic Network (AERONET), providing information on the vertical properties of both aerosols and clouds. MPLNET began in 2000, and has grown to include ~80 sites worldwide. MPLNET data is collected continuously, offering the ability to examine diurnal changes in aerosol and cloud properties. To date, twelve sites have over 10 years of data and more will hit this milestone soon. Here we present early results from development of Level 3 monthly diurnal climatologies from MPLNET.

Index Terms— Lidar, Aerosol, Cloud

1. INTRODUCTION

Over the past 20 years satellite measurements have begun to provide a majority of the long-term climatologies of key atmospheric composition data. However, most of these satellite observations are from sun-synchronous orbital platforms limiting observations to once a day (or twice if nighttime observations are possible). New geosynchronous satellite sensors provide diurnal observations for a limited set of atmospheric composition data, with the notable exception of high resolution vertical profiling. Long-term and continuous ground-based network observations offer the unique ability to produce diurnal climatologies for a wide range of atmospheric composition parameters.

2. NETWORK OVERVIEW

The NASA Micro-Pulse Lidar Network (MPLNET) [1] is a global federated network of polarized Micro-Pulse Lidar (MPL) systems, with most sites co-located with the NASA Aerosol Robotic Network (AERONET) [2] to provide joint

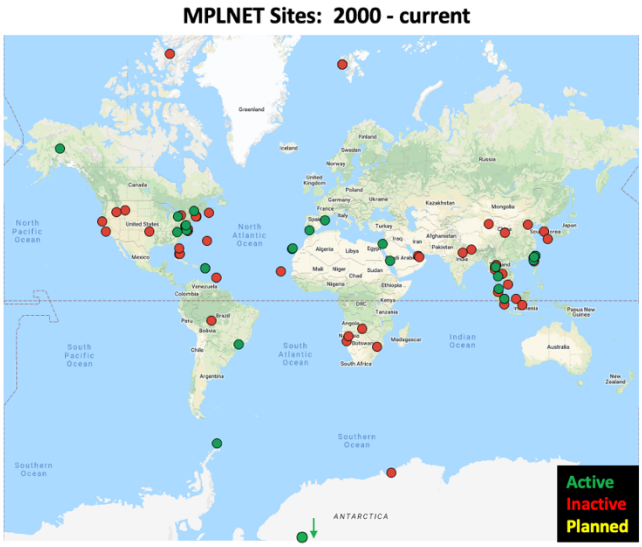

Figure 1. Map of MPLNET sites.

data on column and vertically resolved aerosol and cloud data. MPLNET lidars run continuously, capturing the full diurnal cycle. AERONET instruments observe periodically, but capture the full daytime cycle with limited night time measurements of aerosol optical depth from lunar observations. MPLNET began in 2000, and there have been ~80 sites deployed worldwide, with 26 sites currently active and a few more planned over the next year. Twelve of the long-term MPLNET sites have 10+ years of data, and several more have 5+ years. Figure 1 displays a map of all MPLNET sites since 2000.

3. RESULTS

The new Version 3 MPLNET processing system and product suite was released last year, including expanded data products and variables, new online tools and web services, and near-real time product delivery. Version 3 data

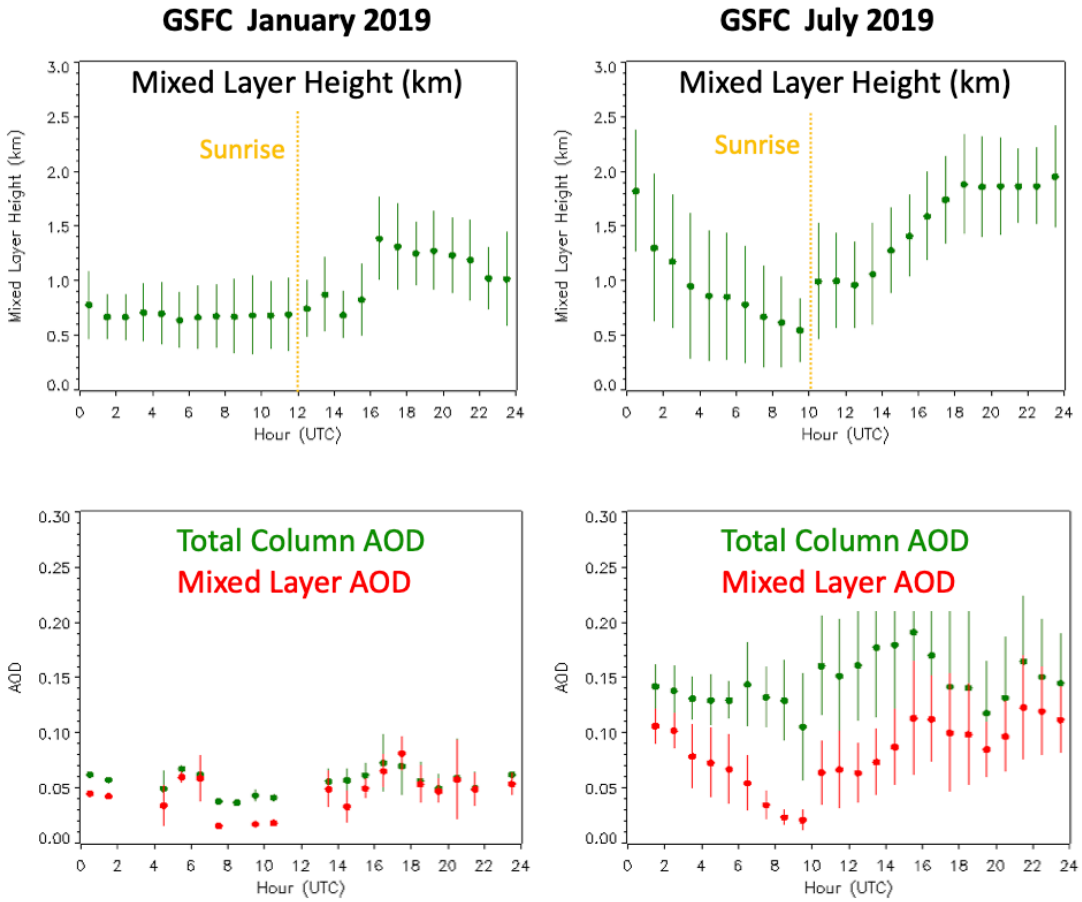

Figure 2. Example of MPLNET monthly diurnal climatologies for

include near real time Level 1 and Level 1.5 (quality assured) products, and final quality assured Level 2 products. With the introduction of Version 3, we have begun development of new Level 3 products (regridded climatologies). Here we will present early results from several of our long-term sites demonstrating the capability of such networks to provide long term diurnal climatologies of aerosol and cloud parameters.

Our standard L3 products are still in development, but will include monthly diurnal averages of all our data products, and corresponding data variables. More information on MPLNET data products can be found online at https://mplnet.gsfc.nasa.gov/product-info/.

Results will be shown for several of our long term MPLNET sites, including data variables such as:

- low, mid, and high cloud fractions
- mixed layer height
- total column and mixed layer aerosol optical depth
- aerosol lidar ratio
- aerosol backscatter profiles

An example of monthly diurnal climatologies at the GSFC site in Maryland USA is shown in Figure 2. The left panels show results from January 2019, and the right from July of the same year to demonstrate seasonal variability. The top panels show retrievals of mixed layer height from MPLNET, and the bottom panels show the total column AOD from AERONET (green) and the mixed layer AOD from MPLNET (red). The results show a more pronounced diurnal cycle in summer, with a higher daytime mixed layer height. There were AOD in summer, but both months show a negligible diurnal cycle in total column AOD. There is relatively small free troposphere AOD of <0.05 in daytime indicating that during this month most aerosol are within the mixed layer. Nighttime free troposphere AOD peak at about 0.1 and are due to residual layers leftover as the mixed layer collapses at night.

4. REFERENCES

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